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This programed mathematics textbook is for student use in vocational education courses. It was developed as part of a programed series covering 21 mathematical competencies which were identified by university researchers through task analysis of several occupational clusters. The development of a sequential content structure was also based on these mathematics competencies. After completion of this program the student should know that a number X having an exponent n means that X is multiplied by itself n times and be able to perform addition, subtraction, multiplication, and division with numbers containing exponents, convert any number into standard scientific notation, convert a number from standard notation into standard decimal notation, and perform addition, subtraction, multiplication, and division using scientific notation. The material is to be used by individual students under teacher supervision. Twenty-six other programed texts and an introductory volume are available as VT 006 882-VT 006 909, and VT 006 975. (EM)

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BOOKLET 11

OF

Report No. 16-S

Occupational Mathematics

SCIENTIFIC NOTATION

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Now that you have the necessary background, let's see how to use it.

You probably know that the sun is 193,000,000 miles from the earth. Sometimes it is more convenient to write this number using <u>scientific notation</u>. This is simply another way to express a number without writing all the zeroes. We can say that 193,000,000 = 1.93×10^{8}. Similarly, .0000193 = 1.93×10^{-5}.

All we have done is move the decimal point one place to the right of the first non-zero integer. We then must multiply by a power of 10 which depends on how far the decimal point was moved. 1.93×10^{8} merely means to move the decimal point 8 places to the <u>right</u> (which is the same as multiplying 1.93 by 100,000,000). So 1.93×10^{8} = 193,000,000.

In our other example, 1.93×10^{-5} means to move the decimal point 5 places to the <u>left</u>. (Which is the same as multiplying by .00001). So 1.93×10^{-5} = .0000193.

Continued on next page

Here are a few more examples:

Number	Number in Scientific Notation
923	9.23×10^2
1741	1.741×10^3
38,412,910	3.84×10^7 (approximate)
.0071	7.1×10^{-3}
.0000500	5.0×10^{-5}

Now turn to page 120 for a problem. Be sure you understand before going on.

See if you can express 385 using scientific notation.

(a) 38.5×10 Turn to page 129

(b) 3.85×10^2 Turn to page 125

(c) $.385 \times 10^3$ Turn to page 124

I think you missed some of the main ideas about scientific notation.

Go back and study page 119 very carefully. Then continue from there.

Turn to page 119.

Yes, 210,000 was correct!

Now, see if you can do this one.

The number 9.71×10^3 is equal to:

(a) 971 Turn to page 133

(b) 9710 Turn to page 134

Your answer of 4700 is equal to 4.7×10^3.

Now see if you can do the problem on page 125 correctly.

Turn to page 125.

It is true that your answer is equal to 385. But it is conventional to put the decimal point one place to the right of the first non-zero digit. This means that $385 = 3.85 \times 10^2$ was the correct answer.

In any number expressed in scientific notation, there will <u>always</u> be exactly one whole number to the left of the decimal point.

Turn to page 128.

Very good!

Here's one a little different.

Another way to write 4.7×10^4 is:

(a) 47,000 Turn to page 134

(b) 4,700 Turn to page 123

(c) .47 Turn to page 126

Your answer of .47 is equal to 4.7×10^{-1} in scientific notation. The correct answer was that 4.7×10^{4} = 47,000.

Now see if you can do better on this one.

What number is equal to 2.1×10^{5}?

(a) .000021 Turn to page 131

(b) 210 Turn to page 133

(c) 210,000 Turn to page 122

Your answer was correct!

Try this one.

32,561 can be written as:

(a) 3.2561×10^4 Turn to page 125

(b) 325.61×10^4 Turn to page 133

Now see if you can apply what you just read.

Express 218.60 in scientific notation.

(a) 2.186×10^2 Turn to page 127

(b) 21,860 Turn to page 132

(c) $21{,}860 \times 10^2$ Turn to page 130

It is true that your answer is equal to 385. But it is conventional to put the decimal point one place to the right of the first non-zero digit. This means that $385 = 3.85 \times 10^2$ was the correct answer.

In any number expressed in scientific notation, there will <u>always</u> be exactly one whole number to the left of the decimal point.

Turn to page 128.

The correct answer was that $218.60 = 2.186 \times 10^2$.
Your answer of $21,860 \times 10^2$ would be the same as
2,186,000. Do you see where you made your mistake?

Try this one.

The number 8,124 in scientific notation is:

(a) 8.124 Turn to page 121

(b) 8.124×10^3 Turn to page 127

(c) 81.24×10^3 Turn to page 133

Watch it! What you wrote was 2.1×10^{-5}.

Go back to page 126 and read more carefully.

Turn to page 126.

Wait a minute! You did two things wrong. First of all, 21,860 is not scientific notation. Also, do you really mean that 218.60 = 21,860?

You'd better go back to page 128 and think a little more about the problem.

Turn to page 128.

I think you missed some of the main ideas about scientific notation.

Go back and study page 119 very carefully. Then continue from there.

Turn to page 119.

Good! You're doing fine on large numbers. Let's see how you can do on some small numbers.

Remember, small numbers are very similar to large numbers in scientific notation. The difference is that numbers less than 1 must be shown by using negative exponents, i.e.:

$$.002 = 2 \times 10^{-3}.$$

Turn to page 142 for a problem now.

Right!

Here's one more.

The value of .007 is the same as:

(a) 700 Turn to page 139

(b) 7.0×10^{3} Turn to page 140

(c) 7.0×10^{-3} Turn to page 150

Very good! Maybe you have it this time.

Try this problem.

An equivalent way to write .00035 is:

(a)	.35	Turn to page 146
(b)	3.5×10^{-4}	Turn to page 138
(c)	35.0	Turn to page 140

You said that .000713 = 713. The correct answer was that .000713 = 7.13×10^{-4}.

Whenever you move a decimal point, you must allow for it by showing a power of ten in the new representation. In this problem you should have moved the decimal point 4 places. Since the original number was less than 1.0, the exponent will be a negative 4, hence 7.13×10^{-4}.

Now let's see if you can do the next one.

Turn to page 145.

Fine!

Let's see if you can do one a little different.

What is another way to express 9.675×10^{-2}?

(a) .09675 Turn to page 150

(b) .0009675 Turn to page 144

(c) 967.5 Turn to page 143

I don't think you understand some of the main ideas.

It would help you to go back and restudy the material on page 119. Then continue from there.

Turn to page 119.

You made a bad mistake. You tried to move the decimal point without using a power of 10 to show how far you moved it. You wouldn't say 2 = 200, would you? Of course not! But $2 \times 10^2 = 200$.

It is important to remember this:

> If you move a decimal point, you <u>must</u> have a power of 10 to show how far you moved it.

Now try this problem.

.013 in scientific notation is:

(a) 1.3×10^{-2} Turn to page 136

(b) $.013 \times 10^{-2}$ Turn to page 148

(c) .13 Turn to page 139

You said that .000713 = 7.13×10^4. Let's see why this is incorrect.

$7.13 \times 10^4 = 7.13 \times 10{,}000 = 71{,}300$. Do you see now? The correct answer was that .000713 = 7.13×10^{-4}. The number of digits you moved the decimal tells you the size of the exponent. Since the original number was less than 1.0, the exponent will be negative. Hence, -4 in our problem.

Now let's see if you can do the next one.

Turn to page 145.

Express the number .000713 in scientific notation.

(a) 713 Turn to page 137

(b) 7.13×10^{4} Turn to page 141

(c) 7.13×10^{-4} Turn to page 138

Did you read the last problem correctly? Your answer represented 9.675×10^{2}. The problem was 9.675×10^{-2}.

Go back to page 138 and see if you can do better this time.

Turn to page 138.

Your answer of .0009675 would equal 9.675×10^{-4}. That is merely because you move the decimal point 4 places. But our problem was 9.675×10^{-2}, so you should have .09675 after moving the decimal point 2 places.

How can you write 8.3×10^{-4}?

(a) 83,000 Turn to page 149

(b) .83 Turn to page 148

(c) .00083 Turn to page 135

Here is one a little easier than the last.

Express .058 using scientific notation.

(a) 5.8 Turn to page 140

(b) $.58 \times 10^{-1}$ Turn to page 147

(c) 5.8×10^{-2} Turn to page 136

You made a bad mistake. You tried to move the decimal point without using a power of 10 to show how far you moved it. You wouldn't say 2 = 200, would you? Of course not! But $2 \times 10^2 = 200$.

It is important to remember this:

> If you move a decimal point, you <u>must</u> have a power of 10 to show how far you moved it.

Now try this problem.

.013 in scientific notation is:

(a) 1.3×10^{-2} Turn to page 136

(b) $.013 \times 10^{-2}$ Turn to page 148

(c) .13 Turn to page 139

Yes, $.58 \times 10^{-1}$ is the same as .058.

But remember the conventional. We normally move the decimal point to the right of the first non-zero digit.

Go back to page 145 and keep this in mind.

Turn to page 145.

I don't think you understand some of the main ideas.

It would help you to go back and restudy the material on page 119. Then continue from there.

Turn to page 119.

You said 83,000 = 8.3×10^{-4}.

Is this the answer you meant to choose?

(a)	Yes	Turn to page 148
(b)	No	Turn to page 144 and look at the problem only

Good! Now you are ready to see how scientific notation can be used.

Let us first look at addition and subtraction using scientific notation. You will need to recall what you learned about exponents.

Remember that in addition and subtraction the exponents had to be the same before you could add or subtract. This also holds using scientific notation. The powers of 10 must be the same before you can add or subtract. Then you simply add or subtract the numbers, keeping the power of 10 the same. Here is an example:

$$3.71 \times 10^4 + 5.13 \times 10^4 = 8.84 \times 10^4$$

We merely add 3.71 and 5.13 and do not change the power of ten. Here's a tougher example:

Add: 412×10^2
$+ \underline{3.13 \times 10^4}$

We first write 412×10^2 as 4.12×10^4. Now we simply add to get 7.25×10^4.

Continued on next page

Here's one more:

$$\left.\begin{array}{r} 47.8 \times 10^{2} \\ -\ .321 \times 10^{4} \end{array}\right\} \quad \begin{array}{r} 4.78 \times 10^{3} \\ -\ 3.21 \times 10^{3} \\ \hline 1.57 \times 10^{3} \end{array}$$

Notice that you can move the decimal points however you wish, as long as you do not change the overall value of the number.

Turn to page 151.

All right! Let's see if you understand the ideas just discussed.

Add 3.6×10^5 and 2.08×10^5.

(a) 5.68×10^5 Turn to page 157

(b) 5.68×10^{10} Turn to page 161

(c) 5.14×10^5 Turn to page 156

Correct!

See if you can do another.

Add these:
$$\begin{array}{r} 2.71 \times 10^4 \\ +\ 1.6 \times 10^4 \\ \hline \end{array}$$

(a) 4.31 — Turn to page 153

(b) 4.31×10^4 — Turn to page 157

(c) 4.31×10^8 — Turn to page 154

You seem to have forgotten the basic rules for adding numbers containing exponents. Before proceeding, you need to review this important area.

Turn to page 23 of Booklet I and work through a few of the problems for a review. Then return to page 150 of Booklet II.

Turn to page 23, Booklet I.

You seem to have forgotten the basic rules for adding numbers containing exponents. Before proceeding, you need to review this important area.

Turn to page 23 of Booklet I and work through a few of the problems for a review. Then return to page 150 of Booklet II.

Turn to page 23, Booklet I.

Wow! What did you do?

You <u>should</u> have written both numbers using scientific notation and then added them. You do <u>not</u> add exponents.

Now try this one.

Add 31.2×10^2 and 1.6×10^3 and express your answer using scientific notation.

(a) 32.8×10^5 Turn to page 153

(b) 48.2×10^2 Turn to page 154

(c) 4.72×10^3 Turn to page 160

I think you were a little careless in your addition.

Go back to page 151 and add the numbers again.

Turn to page 151.

Excellent! Keep up the good work.

Here's a little harder one.

Add (467×10^2) and (31.2×10^3) and express your answer using scientific notation.

(a) 779×10^2 Turn to page 159

(b) 7.79×10^4 Turn to page 162

(c) 498.2×10^5 Turn to page 155

Here is your next problem.

What is $2 \times 10^2 + 3 \times 10^2$?

(a) 5×10^2 Turn to page 152

(b) 5×10^4 Turn to page 153

Yes, your answer of 789×10^2 would give the correct value. But remember that in scientific notation there is <u>always</u> a decimal point after the first non-zero integer.

See if one of the answers on page 157 is written in proper form.

Turn to page 157.

Correct!

Try this one.

What is: $17.98 \times 10^3 + 133 \times 10^2$

(a) 3.128×10^4 Turn to page 162

(b) 19.21×10^4 Turn to page 153

(c) 150.98×10^3 Turn to page 154

Watch it! You made the mistake of adding the exponents. Remember, in addition and subtraction you keep the same exponent.

So $3.6 \times 10^5 + 2.08 \times 10^5 = 5.68 \times 10^5$. This is a very important idea to keep in mind as you continue.

Turn to page 158.

You're doing fine!

The next couple problems deal with subtraction.
Like addition, the exponents must be the same before
you subtract.

Subtract: 8.7×10^{-4} / $- .65 \times 10^{-3}$ — Express your answer in conventional scientific notation.

(a) $.22 \times 10^{-3}$ Turn to page 170

(b) 2.2×10^{-4} Turn to page 169

(c) 8.05×10^{-1} Turn to page 167

Excellent! Maybe you have it this time.

Let's try one more to see if you can get back on the right track.

Subtract 1.47×10^7 from 224.8×10^5 and write your answer using scientific notation.

(a) 77.8×10^5 Turn to page 164

(b) 7.78×10^6 Turn to page 169

(c) 223.33×10^5 Turn to page 176

Yes, 77.8×10^5 would give the correct answer. But this answer is not in standard form for scientific notation.

Go back to page 163 and choose the answer in proper form.

Turn to page 163.

Very good!

Let's continue.

What is $7.4 \times 10^6 - .003 \times 10^6$

(a) 7.3007×10^6 Turn to page 176

(b) 7.1×10^5 Turn to page 187

(c) You can't subtract them Turn to page 175

You didn't read the problem very carefully. It said to <u>subtract</u>.

Better go back to page 169 and try again.

Turn to page 169.

Incorrect. In this type problem the first thing you must do is change both quantities to numbers having the same exponent.

For example: 83.2×10^{-5}
$- \underline{.48 \times 10^{-3}}$

becomes 8.32×10^{-4}
$- \underline{4.8 \times 10^{-4}}$

Subtracting, we get 3.52×10^{-4}. Notice that -4 stays as the exponent in the final answer.

Turn to page 177.

No. You still don't have it.

Maybe you are trying to go too fast. Slow down a little and see if you can follow the example on page 167. Then continue from there.

Turn to page 167.

Exactly right! Keep up the good work.

Let's see if you can do this one now.

What is $(9.61 \times 10^3) - (.70 \times 10^2)$?

(a) 9.54×10^3 Turn to page 187

(b) 9.68×10^3 Turn to page 166

(c) 8.91×10^1 Turn to page 171

You're close. Your answer of $.22 \times 10^{-3}$ does give the right number. But it isn't in standard form for scientific notation. Remember, the decimal point should be to the right of the first positive integer.

Now go back to page 162 and select the correct answer.

Turn to page 162.

Incorrect.

Recall that before you subtract, you must first be sure that the exponents are both the same. The correct solution is:

$$\begin{array}{r} 9.61 \times 10^{3} \\ -\ .70 \times 10^{2} \\ \hline \end{array} \quad = \quad \begin{array}{r} 9.61 \times 10^{3} \\ -\ .07 \times 10^{3} \\ \hline 9.54 \times 10^{3} \end{array} \leftarrow\text{---}\ \text{Answer}$$

Try this one.

What is $(1.47 \times 10^{6}) - (8.3 \times 10^{5})$?

(a) 6.4×10^{5} Turn to page 165

(b) -6.83×10^{6} Turn to page 176

(c) You can't subtract them Turn to page 174

No. You still don't have it.

Maybe you are trying to go too fast. Slow down a little and see if you can follow the example on page 167. Then continue from there.

Turn to page 167.

Come on, now. I don't think you paid close attention to what you just read two pages ago.

You'd better go back to page 167 and read carefully this time.

Turn to page 167.

Yes, the numbers can be subtracted.

Here's a hint. For purposes of the subtraction, change 1.47×10^6 to 14.7×10^5. Now go back to page 171 and see if you can do it.

Turn to page 171.

Yes, the numbers can be subtracted.

Try changing .003 x 10^8 into an equivalent number with 6 as the exponent. Go back to page 165 and try again.

Turn to page 165.

Incorrect. You should recall from page 162 that both exponents must be the same before you subtract.

Here is an example:

$$\begin{array}{r} 14.72 \times 10^{4} \\ -\ \underline{60.5 \times 10^{3}} \end{array} \quad \text{becomes} \quad \begin{array}{r} 14.72 \times 10^{4} \\ -\ \underline{6.05 \times 10^{4}} \\ 8.67 \times 10^{4} \end{array}$$

Notice that the exponents are both 4 before you subtract.

Keeping this in mind, try this one.

What is $\begin{array}{r} 14.68 \times 10^{3} \\ -\ \underline{1.27 \times 10^{4}} \end{array}$?

(a) 1.98×10^{4} Turn to page 168

(b) 1.341×10^{2} Turn to page 172

(c) 1.98×10^{3} Turn to page 163

Let's see if you can do one now.

What is $(3.7 \times 10^{-2}) - (11 \times 10^{-3})$?

(a) .026 Turn to page 173

(b) 3.59×10^{-3} Turn to page 176

(c) 2.6×10^{-2} Turn to page 163

The number you chose was correct. But it is not written using scientific notation. The number 5,699,200,000,000 is 5.6992×10^{12} using scientific notation.

On the next problem be sure to use scientific notation.

Turn to page 181.

Incorrect. The correct answer was 1.683×10^6.

Try this one.

Express (32)·(65) in <u>scientific notation</u>.

(a) 2,080 Turn to page 191

(b) 2.08 Turn to page 188

(c) 2.08×10^3 Turn to page 184

Excellent!

Here's another to multiply.

What is the product of $(18.7 \times 10^{8}) \cdot (0.9 \times 10^{-3})$?

(a) 16.83×10^{-24} Turn to page 182

(b) 1.683×10^{6} Turn to page 192

(c) 16.83×10^{2} Turn to page 179

Express the product of (18,000) · (230) with scientific notation.

(a) 4.14×10^6 Turn to page 186

(b) 4.14×10^8 Turn to page 188

(c) 4,140,000 Turn to page 183

Incorrect. You multiplied the exponents together.

You'd better review the method needed for multiplication as explained on page 187.

Turn to page 187.

You're not following instructions very well.

Go back to page 181 and do what the problem asks.

Turn to page 181.

Good! You got that one right. Keep up the good work.

Express $(1.9 \times 10^{-3}) \cdot (3.6 \times 10^{-2})$ in scientific notation.

(a) 6.84×10^{6} Turn to page 188

(b) 6.84×10^{-5} Turn to page 192

Here's your problem.

Express the product of (137,000,000) · (41,600) in scientific notation.

(a) 5.6992×10^{12} Turn to page 180

(b) 5,699,200,000,000 Turn to page 178

(c) I'm not sure how Turn to page 189

Correct! That's better.

Let's see if you can get this one.

Express (.0071) · (.018) in scientific notation.

(a) .0001278 Turn to page 190

(b) 1.278×10^{-4} Turn to page 180

(c) I'm not sure what to do Turn to page 188

Very good! Now let's take a look at some multiplication problems.

Example 1:

$(2.3 \times 10^4) \cdot (6.1 \times 10^3) = 14.03 \times 10^7 = 1.403 \times 10^8$

Example 2:

$(15 \times 10^{-2}) \cdot (2.1 \times 10^{-4}) = 31.5 \times 10^{-6} = 3.15 \times 10^{-5}$

There are three things you need to remember to do multiplication:

(1) Multiply the leading numbers

(2) Add the exponents

(3) Change the final number to standard scientific notation (where the decimal is to the right of the first positive integer).

If the numbers being multiplied are not in scientific notation, simply convert them before you start.

Example 3:

(50,000) · (170,000)

First convert to scientific notation. The problem is now $(5.0 \times 10^4) \cdot (1.7 \times 10^5) = 8.5 \times 10^9$.

Continued on next page

Example 4:

$(.00012) \cdot (.0035) = (1.2 \times 10^{-4}) \cdot (3.5 \times 10^{-3}) =$

4.20×10^{-7}

Study these examples carefully. When you are ready to try one yourself, turn to page 185.

Turn to page 185.

You don't seem to have the idea completely.

Go back and study the material on page 187 very carefully.

Turn to page 187.

Here are some clues to help you get started.

$(137,000,000) = 1.37 \times 10^8$

$(41,600) = 4.16 \times 10^4$

Now simply multiply the numbers at the front of each and add the exponents. Go back to page 185 now and try again.

Turn to page 185.

No. You weren't very careful in reading the last problem.

Go back to page 186 and take a little more time to be accurate.

Turn to page 186.

Come on, now. 2,080 is not in scientific notation.

Go back and choose the answer on page 179 that is in correct form.

Turn to page 179.

Excellent! Now you should be ready to do some division problems.

Example 1: $(8.64 \times 10^8) \div (2.4 \times 10^5) = \frac{8.64}{2.4} \times 10^{(8-5)} = 3.6 \times 10^3$

Example 2: $(50.22 \times 10^6) / (9.3 \times 10^2) = \frac{50.22}{9.3} \times 10^{6-2} = 5.4 \times 10^4$

The steps to follow in division are:

(1) Divide the leading numbers

(2) Subtract the exponents

(3) Change the final answer to standard scientific notation if it isn't already expressed that way.

If the numbers being divided are not in scientific notation, simply convert them before you start.

Example 3: $(2{,}976{,}000) / (4{,}800) = (2.976 \times 10^6) / (4.8 \times 10^3) = \frac{2.976}{4.8} \times 10^{6-3} = .62 \times 10^3 = 6.2 \times 10^2$ in standard form.

Example 4: $(.000001092) \div (.00012) = (1.092 \times 10^{-6}) \div (1.2 \times 10^{-4}) = \frac{1.092}{1.2} \times 10^{-2} = .91 \times 10^{-2} = 9.1 \times 10^{-3}$ in standard form.

Study the examples on this page carefully. When you are ready to try one yourself, turn to page 193.

What is $\frac{5.6092 \times 10^{8}}{3.79 \times 10^{3}}$? Express your answer using scientific notation.

(a) $1.48 \times 10^{2.7}$ Turn to page 197

(b) 1.48×10^{5} Turn to page 196

(c) 1.48×10^{7} Turn to page 209

Fine! 3.2×10^{-2} was the correct answer.

Now, what is $(.00092) \div (4.0 \times 10^{-3})$?

(a) 2.3×10^{-1} Turn to page 198

(b) .0023 Turn to page 205

(c) 230 Turn to page 195

Your choice of answer means that you do not understand how to divide using scientific notation.

Study page 192 very carefully. Then see if you can proceed correctly from there.

Turn to page 192.

Correct! You're doing fine.

Here's one a little tougher.

Express the following quotient in scientific notation:

$$\frac{.0000000092}{.000038}$$

(a) 4.13×10^{-4} Turn to page 207

(b) 2.42×10^{-4} Turn to page 198

(c) 24,200 Turn to page 199

Your answer was incorrect. Let's look at the correct solution.

$$\frac{5.6092 \times 10^{8}}{3.79 \times 10^{3}} = \frac{5.6092}{3.79} \times 10^{5} = 1.48 \times 10^{5}$$

It's really very easy. In this one all you had to do was divide the leading numbers and subtract the exponents.

See if you can do these things on the next problem.

Turn to page 200.

Very fine work! You have successfully come to the end of the Unit.

Because there were so many ideas in this Unit, most of them were discussed only briefly. You will probably need some additional practice on your own in order to remember everything that was discussed.

You may wish to review some of the material covered in this Unit. It has been broken into sections for your convenience.

Turn to page 201.

Let's look at the correct solution to the last problem.

$$\frac{.0000000092}{.000038} = \frac{9.2 \times 10^{-9}}{3.8 \times 10^{-5}} = \frac{9.2}{3.8} \times 10^{-4} = 2.42 \times 10^{-4}.$$

See if you can get this one.

$$\frac{.0000832}{.0026} = ?$$

(a) 3.2×10^{-2} Turn to page 194

(b) $.32 \times 10^{3}$ Turn to page 202

(c) 320 Turn to page 208

All right!

See if you can get this one.

In scientific notation, the value of $(9.6 \times 10^5) \div (3.2 \times 10^2)$ is:

(a)	30	Turn to page 210
(b)	3.0×10^3	Turn to page 204
(c)	$.33 \times 10^4$	Turn to page 203

For help on	Refer to These Pages
1. Meaning of an exponent	1 - 22
2. Addition and subtraction using exponents	23 - 45
3. Multiplication with exponents	46 - 60 (start at 47)
4. Division with exponents	61 - 74
5. Use of 0 as exponent	75 - 84 (start at 76)
6. Negative exponents	85 - 118
7. Concept for scientific notation	119 - 149
8. Addition using scientific notation	150 - 161
9. Subtraction using scientific notation	162 - 177
10. Multiplication using scientific notation	178 - 191
11. Division using scientific notation	192 - 210

When you have completed any review you wish to do,

see your teacher for the test on Unit 18.

The correct answer was that $(9.6 \times 10^5) \div (3.2 \times 10^2) = 3.0 \times 10^3$.

Here's one that should help you get back on the right track.

What is $(8 \times 10^7) / (2 \times 10^2)$?

(a) 4×10^5 Turn to page 204

(b) 400 Turn to page 205

(c) I'm not sure Turn to page 195

Fine! Your answer was correct.

Try this one.

Express $\frac{2.52 \times 10^4}{7.2}$ in scientific notation.

(a) $.35 \times 10^4$ Turn to page 206

(b) 3.5×10^3 Turn to page 196

(c) 350 Turn to page 205

Your choice of answer means that you do not understand how to divide using scientific notation.

Study page 192 very carefully. Then see if you can proceed correctly from there.

Turn to page 192.

Pretty close. But your answer of $.35 \times 10^4$ is not in standard form.

Go back to page 204 and see if the answer in standard form is there.

Turn to page 204.

Oh, oh! You were careless on that one. You divided the numbers backward. You always divide the numerator by the denominator.

Go back to page 196 and see if you can do it correctly this time.

Turn to page 196.

The correct answer was 3.2×10^{-2}.

See if you can get back on the track with this one.

$(4.75 \times 10^{-6}) / (.0019) = ?$

(a) 22,500 Turn to page 195

(b) 2.25×10^{-3} Turn to page 194

(c) $.225 \times 10^{4}$ Turn to page 205

Your answer was incorrect. Let's look at the correct solution.

$$\frac{5.6092 \times 10^8}{3.79 \times 10^3} = \frac{5.6092}{3.79} \times 10^5 = 1.48 \times 10^5$$

It's really very easy. In this one all you had to do was divide the leading numbers and subtract the exponents. See if you can do these things on the next problem.

Turn to page 200.

The correct answer was that $(9.6 \times 10^5) \div (3.2 \times 10^2) = 3.0 \times 10^3$.

Here's one that should help you get back on the right track.

What is $(8 \times 10^7) / (2 \times 10^2)$?

(a) 4×10^5 Turn to page 204

(b) 400 Turn to page 205

(c) I'm not sure Turn to page 195

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CAI MATHEMATICS

TEST QUESTIONS

UNIT 18 - SCIENTIFIC NOTATION

1. $X \cdot X \cdot X \cdot X =$

   (a) $4X$
   (b) X
   (c) X^4

2. $(2^3)(2^4) =$

   (a) 2^7
   (b) 4^7
   (c) 2^{12}

3. $2^{-3} =$

   (a) -6
   (b) $1/8$
   (c) $1/6$

4. 6.002×10^{-2}

   (a) .06002
   (b) 600.2
   (c) 60.02

5. $(3 \times 10^5)(6 \times 10^{-2}) =$

   (a) 18×10^{-10}
   (b) 9×10^3
   (c) 18×10^3

6. Subtract 2.28×10^5 from 361.76×10^3

   (a) 359.48×10^5
   (b) 1.3376×10^2
   (c) 359.48×10^2
   (d) 1.3376×10^5

7. 2^6 =

(a) $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

(b) $6 \cdot 6$

(c) $6 \cdot 2$

8. 20.032 written in scientific notation is:

(a) 2.0032×10^4

(b) 2.0032×10^{-1}

(c) 2.0032×10^1

9. $(X^4)(X^2)$ =

(a) $2X^6$

(b) X^6

(c) $2X^8$

(d) X^8

10. 10^{-4} =

(a) $\frac{1}{1000}$

(b) -40

(c) .0001

11. $3.6 \times 10^4 + 2.85 \times 10^4$ =

(a) 6.45×10^8

(b) 3.21×10^4

(c) 6.45×10^4

12. 8015 written in scientific notation is:

(a) $.8015 \times 10^3$

(b) 8.015×10^3

(c) 8.015×10^{-3}

13. $(3A^3)(2A)$ =

(a) $6A^4$

(b) $5A^3$

(c) Neither answer

14. If A = 3, then A^4 =

(a) 12

(b) 81

(c) 64

15. 3.02×10^3 =

(a) .00302

(b) 3020

(c) 32000

16. $6A^3 - A^3$ =

(a) 6

(b) $6A^3$

(c) $5A^3$

17. .003 in scientific notation is:

(a) 3×10^{-3}

(b) .003

(c) $3 \times .001$

18. If x = 2, then 5^x =

(a) 25

(b) 10

(c) 32

19. Express the product of (1500)(21) with scientific notation.

(a) 3.15×10^4

(b) 315×10^5

(c) 31500

20. $12K^4 \div 3K$ =

(a) $9K^3$

(b) $4K^3$

(c) $4K^4$

21. $.72 \times 10^3$ is the same as 7200.

(a) Yes

(b) No

22. $(.00016) \div (2.0 \times 10^{-3}) =$

(a) 8×10^{-3}

(b) $.8 \times 10^{-1}$

(c) 8

23. $K^3 =$

(a) 3^K

(b) $3K$

(c) $K \cdot K \cdot K$

24. $(3.21 \times 10^{-2}) + (1.25 \times 10^3) =$

(a) 1250.0321

(b) 1.571×10^3

(c) 4.46×10^1

25. $A^2 + A =$

(a) A^3

(b) $2A^2$

(c) Neither answer

Answer Sheet - Unit 18

Scientific Notation

1.	c	1
2.	a	2
3.	b	1
4.	a	4
5.	c	5
6.	d	5
7.	a	1
8.	c	3
9.	b	2
10.	c	3
11.	c	5
12.	b	3
13.	a	2
14.	b	1
15.	b	4
16.	c	2
17.	a	3
18.	a	1
19.	a	5
20.	b	2
21.	b	3
22.	a	5
23.	c	1
24.	a	5
25.	c	4